

CLAIMS

We claim:

1. A method of manufacturing a biomedical article, comprising:
depositing a layer of powder;
dispensing, onto portions of the layer of powder, a suspension comprising solid particles of at least one substance selected from the group consisting of: cells, cell fragments, cellular material, proteins, growth factors, bone particles, cartilage particles, other biological or inert materials which are insoluble or nearly insoluble, Active Pharmaceutical Ingredients, and very fine particles of the same material as the powder in the layer of powder;
and repeating the above steps as many times as needed to produce the biomedical article.
2. The method of claim 1 wherein the suspension further comprises suspending agents and/or steric hindrants.
3. The method of claim 1 wherein the suspension further comprises one or more additional API dissolved in the liquid.
4. The method of claim 1 wherein the suspension further comprises one or more binding substances dissolved in the liquid.
5. The method of claim 1 wherein the biomedical article is an implantable device.
6. The method of claim 1 wherein the biomedical article is a bone substitute.

7. The method of claim 1, further comprising, after dispensing, allowing or causing the dispensed suspension to at least partially dry, and dispensing a second suspension containing solid particles of at least one Active Pharmaceutical Ingredient again onto portions of the layer of excipient powder, at least one additional time before depositing the next layer of excipient powder.

8. The method of claim 7 wherein the pattern of deposition during the second printing is different from the pattern during the first printing.

9. The method of claim 1, wherein at least some of the suspended solid particles comprise an amorphous form of Active Pharmaceutical Ingredient.

10. The biomedical article of claim 7 wherein the second substance has a local concentration at local places in the dosage form and wherein the local concentration of the second substance is nonuniform.

11. The biomedical article manufactured by the method of claim 1.

12. A biomedical article comprising:

a powder which is substantially insoluble;

a second substance selected from the group consisting of: cells, cell fragments, cellular material, proteins, growth factors, bone particles, cartilage particles, other biological or inert materials which are insoluble or nearly insoluble, Active Pharmaceutical Ingredients, and very fine particles of the same material as the powder in the layer of powder.

13. A method of three-dimensional printing, comprising dispensing a suspension through a solenoid-operated valve onto powder.

14. The method of claim 12 wherein the valve includes a valve body and within the valve body a seat and a moving part, and a bypass flowpath.

15. The method of claim 12 further comprising flowing suspension continuously through a manifold, and wherein the microvalve is supplied from the manifold.

16. The method of claim 13, wherein the solenoid-operated valve has a valve body and within the valve body a seat and a moving part adapted to fit against the seat and thereby close a flowpath, and further comprising a bypass path emanating from the valve body close to the valve seat, the bypass path being always open.